AIR CURTAIN DESTRUCTOR PERFORMANCE TEST

Quality Assurance Project Plan-Final
Category II/III

Prepared for:
US Environmental Protection Agency
Office of Research and Development
National Risk Management Research Laboratory
Cincinnati, Ohio

Prepared by:
RTI International
3040 Cornwallis Road
Research Triangle Park, North Carolina 27709

and

ARCADIS
4915 Prospectus Drive
Suite F, Durham, North Carolina 27713

US EPA Contract Number EP-C-05-060
Task Order 72
ARCADIS Project No. RN007061.0001

QAPP
May 2008

SECTION A

PROJECT MANAGEMENT

A1. Title and Approval Sheet

Air Curtain Destructor Performance Test (QA Category II/III)

EPA Approvals:

5/8/08
Bob Olexsey
ORD Lead Contact

5/8/08
Paul Lemieux – C. Andrew Miller
Project Officers

5/8/08
Paul W. Groff
QA Representative

RTI International Approvals:

5/7/08
Coleen Northeim
Project Manager

ARCADIS Approvals:

5/6/2008
Johannes Lee
Project Manager

5/6/2008
Laura B. Nessley
QA Officer

5/6/2008
Gene Stephenson
Project Engineer

This page intentionally left blank.

A2. Table of Contents

List of Tables

List of Figures

A3. Distribution List

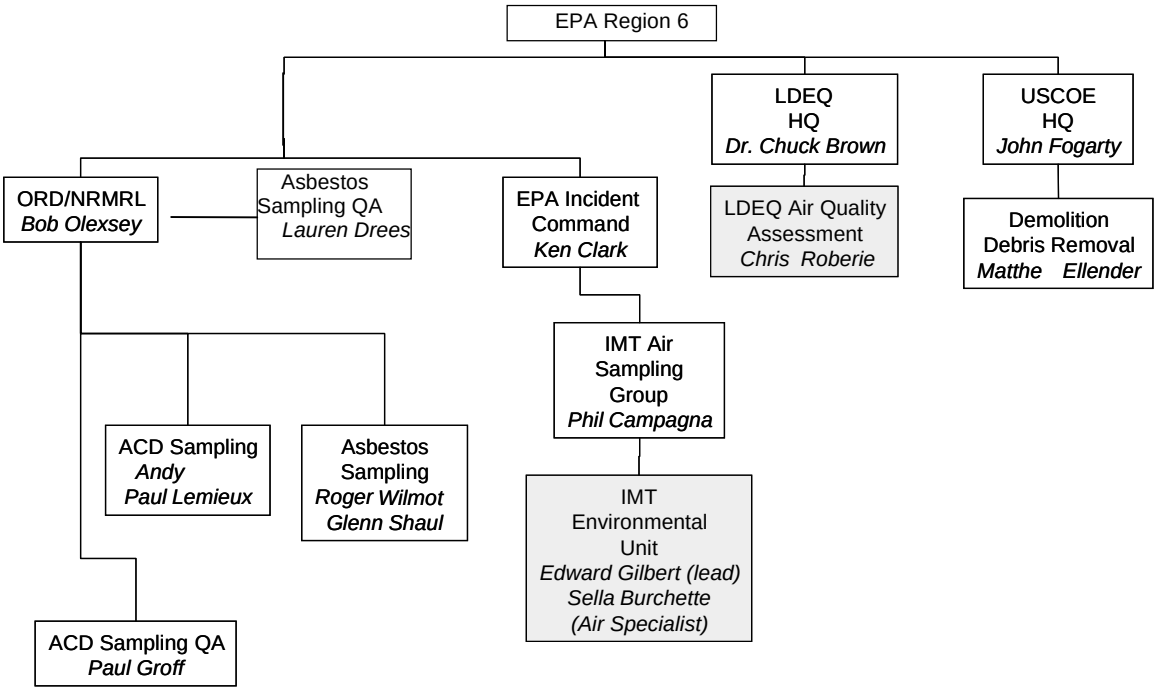
Copies of this QAPP have been distributed to the following personnel. It is the responsibility of the ARCADIS QA Officer to ensure that each person on the list has the most recent version of this QAPP.

Bob Olexsey	ORD Lead Contact
Nancy Jones	EPA Region 6 Project Head
Andy Miller, Paul Lemieux	EPA Project Officers
Coleen Northeim	RTI International Project Manager
Johannes Lee	ARCADIS Project Manager
Gene Stephenson	ARCADIS Project Engineer
Paul Groff	EPA APB QA Representative
Laura Beach Nessley	ARCADIS QA Officer
John Nash	ARCADIS Field Team Leader

A4. Project/Task Organization

The project falls within the oversight of EPA Region 6. Nancy Jones heads up the Region's effort. The Incident Command Structure (ICS) set up by Region 6 under the National Incident Management Structure (NIMS) incorporates management teams from the various agencies involved in the response, including EPA and the Louisiana Department of Environmental Quality (LDEQ).

The ORD lead for the project falls under Bob Olexsey, Associate Director for Ecology, National Risk Management Research Laboratory (NRMRL). NRMRL is coordinating this effort with Region 6, the Region 6 Incident Management Team (IMT) located in New Orleans, and LDEQ's Air Quality Assessment group. In addition to these interactions, the EPA Office of Air and Radiation (OAR) and Office of Enforcement and Compliance Assurance (OECA) are also involved in evaluating data, but are not involved in the project itself. ORD's National Center for Environmental Assessment (NCEA) will be performing a risk assessment on the data resulting from these tests.



Shaded boxes indicate data review

Figure 1. Organization Chart for ACD Test Burns

The functional project organization for data collection is outlined in Figure 2. Figure 3 details the ARCADIS project field team. Lines of communication between ARCADIS staff are indicated by solid lines, while dashed lines show anticipated communications lines between EPA staff, RTI International management, and ARCADIS management.

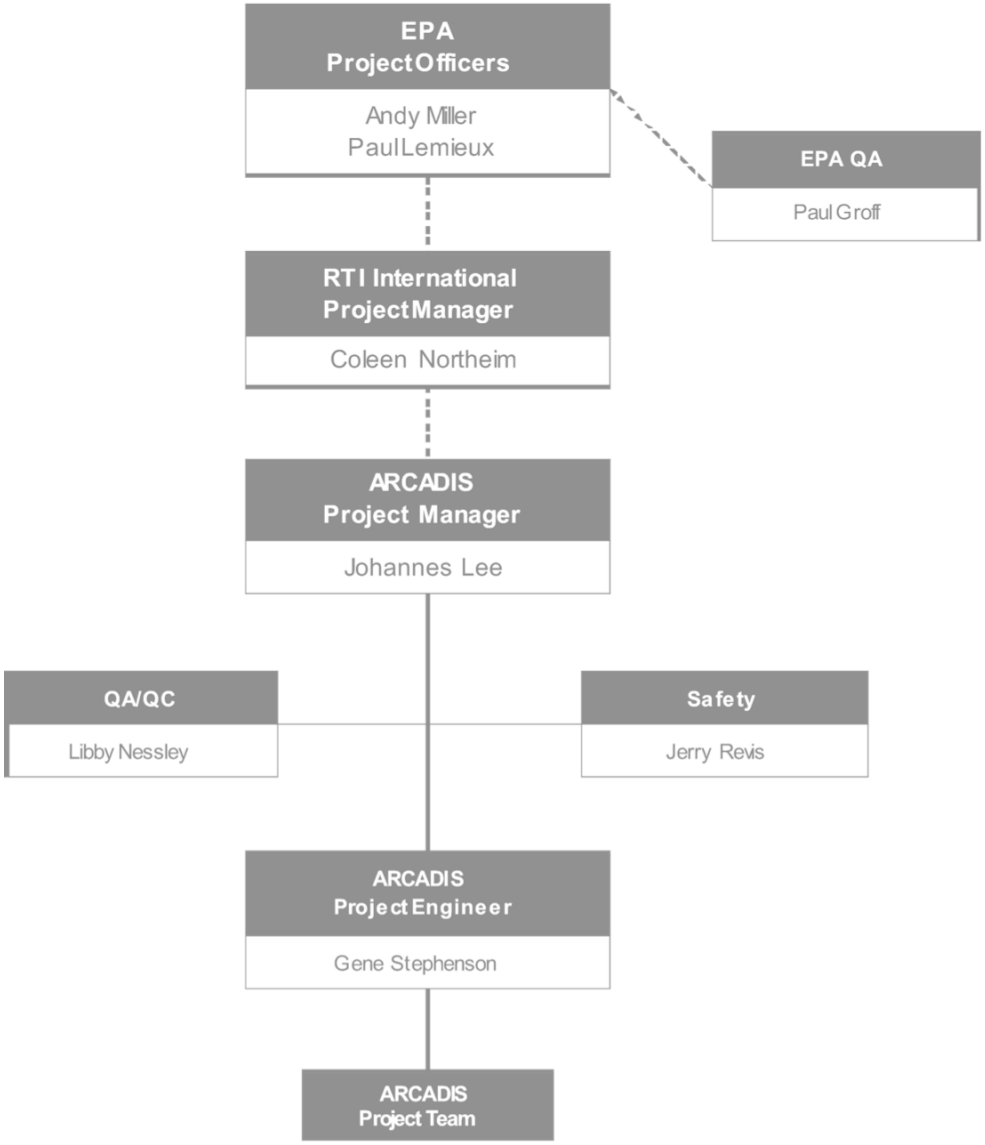


Figure 2. Functional Project Organization Chart

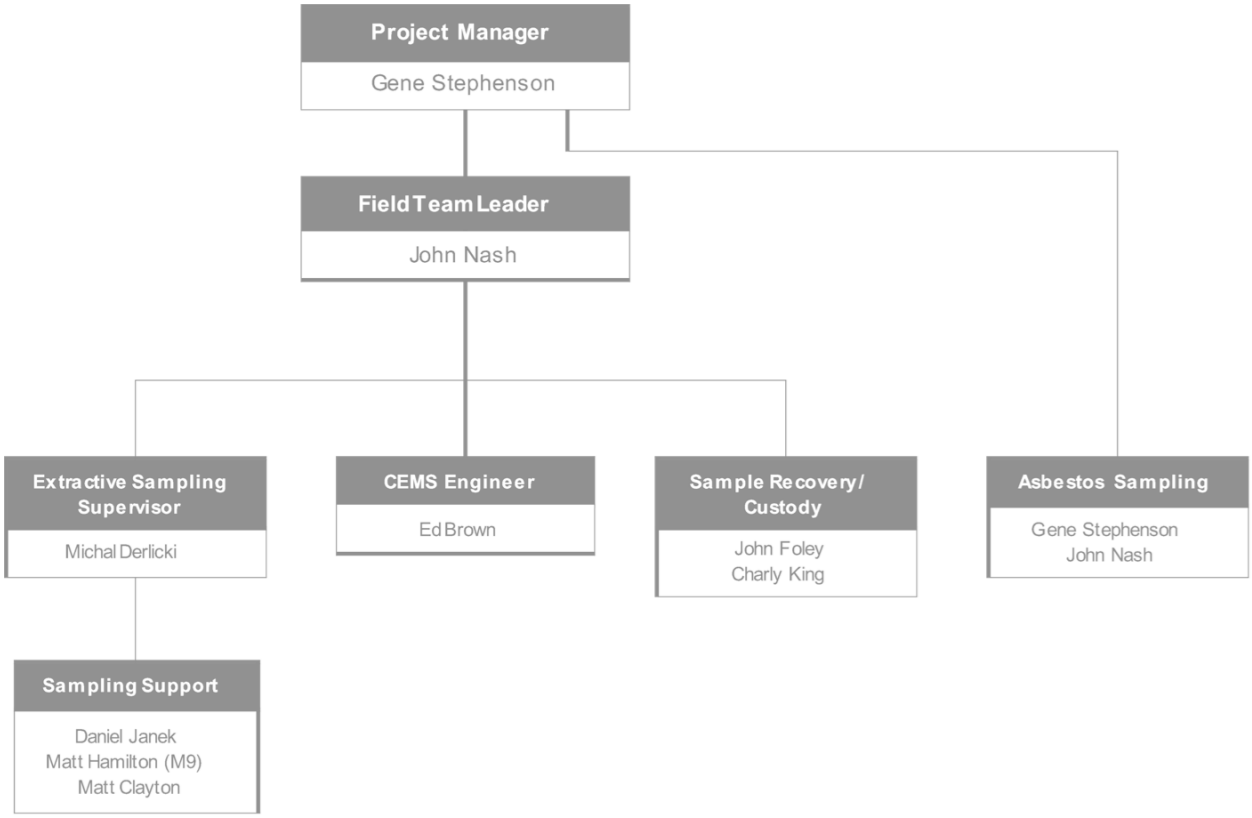


Figure 3. ARCADIS Field Team Organization Chart

Individuals from ARCADIS who are participating in the program, along with their specific roles and responsibilities are listed following:

- Johannes Lee - Acting as the ARCADIS Project Manager, Mr. Lee will have ultimate and overall performance and financial responsibility for the project.
- Gene Stephenson – Acting as the ARCADIS Project Engineer, Mr. Stephenson will oversee the logistical conduct of the program, ensuring that adequate personnel and financial resources are committed to allow success. He will be personally responsible for the asbestos sampling in the field. Additionally, he will act as Data Manager, coordinating information input from the field sampling crew and integrating with laboratory analytical reports. He will be responsible for reviewing 100% of the data generated.
- John Nash - Mr. Nash will coordinate all field activities and will coordinate daily sampling activities with Mr. Stephenson and Drs. Miller and Lemieux to ensure that project goals are met.

- Michal Derlicki – Mr. Derlicki will oversee the extractive sampling processes, including methods for asbestos, PM, SVOCs, VOCs, acid gases, and metals. He will report to Mr. Nash.
- Ed Brown – Mr. Brown will be the CEMS Engineer and will operate the continuous emission monitors throughout testing, inclusive of calibration operations. He will report to Mr. Nash.
- Charly King and John Foley – Mr. King and Mr. Foley will serve as the sampling train recovery chemists. Their responsibilities will include preparation of all reagent materials, recovery of trains after sampling, and preparation of all samples for subsequent laboratory analysis (including preservation and shipment). Mr. King will also serve as Sample Custodian for the project. Both will report to Mr. Nash.
- Daniel Janek, Matt Hamilton, and Matt Clayton – These gentlemen will conduct extractive sampling procedures under supervision by Mr. Derlicki.
- Jerry Revis – Mr. Revis will provide safety oversight for the program, specifying PPE as needed and ensuring that all members of the project team are adequately briefed on the potential hazards identified in the HASP. Mr. Revis does not report to anyone on the project team; rather he reports directly to ARCADIS management.
- Laura Nessley – Ms. Nessley will serve as ARCADIS' QA Officer for the project, ensuring that all members of the project team have been briefed on this QAPP. Additionally, she will arrange for analysis of any performance evaluation samples provided by EPA and will provide for independent review of an additional 20% of the data subsequent to Mr. Stephenson's review. Similar to Mr. Revis, she reports to ARCADIS management independent of the project team.

A5 – Problem Definition/Background

In the aftermath of the devastation caused by Hurricane Katrina, the State of Louisiana and the City of New Orleans are faced with an overwhelming amount of storm-related debris requiring disposal. In addition to vegetative debris including downed trees and limbs, a large number of houses were damaged beyond repair. Given the enormous amount of vegetative, building, and demolition debris created by Hurricane Katrina, coupled with the limited capacity of existing landfills and industrial/commercial incineration facilities capable of handling said waste, combustion in Air Curtain Destructors (ACD) will likely be a key means of reducing the volume of waste requiring disposal. ACDs have been proposed as a potential means of handling waste disposal while minimizing potentially harmful environmental impacts.

In response to Hurricane Katrina' devastating results, the State of Louisiana requested that EPA allow them to demolish residences that were thought to contain asbestos without following all of the material handling and inspection procedures that are normally required. While the State anticipated using practices that would minimize the introduction of asbestos into the air, the

scope of the problem, the need to expedite debris disposal and the condition of many of the homes has made it impossible to completely follow the procedures to the letter in each case. The State therefore requested that EPA provide a No Action Assurance (NAA) letter that would permit the State to use modified processes to demolish residences that were thought to contain asbestos materials but were no longer habitable. This NAA letter will be issued to Region 6 by EPA's Office of Enforcement and Compliance Assurance (OECA) and will cover all parties involved in the program. In addition, the State also asked for permission to dispose of a portion of this debris in ACDs.

EPA responded by outlining a series of conditions that the State of Louisiana would have to meet in order to burn asbestos-containing C&D debris, including a series of tests to demonstrate that any asbestos that may be introduced into an ACD would be transformed from an expected chrysotile form to a more benign form, forsterite. Samples will also be examined for degradation products of other forms of asbestos. EPA's primary criterion for determining this transformation was to maintain a temperature in the ACD of 800 °C or higher. Knowing that other pollutants, some of which would not easily degrade into benign forms, would be emitted from the ACD combustion process, EPA required that the State refrain from any C&D disposal in ACDs until a series of emission tests had been conducted to define ACD operating conditions that would ensure destruction or transformation of the chrysotile asbestos and minimize emissions of other pollutants. The Scope of these tests was evaluated through a consultation by a panel of EPA's Science Advisory Board.

Figure 4 shows a typical design for a commercially available ACD. Operated as an above ground installation, or in some instances, installed in ground, ACDs utilize the general concept that a high volume of air is blown at a slight downward angle into the combustion vessel. The air serves a dual purpose: 1) combustion is enhanced through providing a steady supply of forced excess oxygen with turbulent mixing resulting in achievement of higher temperatures and more thorough consumption of fuel, and 2) the injection of the air at a slightly incident angle forms a "curtain" that creates a recirculation zone and serves as a barrier to the emission of particulate matter (PM) (smoke) and forces longer residence times as opposed to conventional open pit burning.

ACDs have been deployed on numerous occasions by the U.S. Forest Service (USFS) and the U.S. Army Corps of Engineers (USACE) for the reduction of vegetative waste and in some cases for destruction of animal carcasses. Limited data are available on the emissions from these applications, essentially amounting to emissions of CO, filterable particulate matter, and opacity. Furthermore, the demolition debris from Hurricane Katrina presents some unique issues as yet unstudied. One of the more serious problems associated with Katrina is the huge number of homes, many of them older homes, that will have to be demolished and disposed of. Many of these homes are likely to contain asbestos and/or lead-based paints, as well as numerous sources

of chlorine and metals. We are unaware of any reliable information on the potential emission rates from ACDs burning construction and demolition (C&D) debris of harmful species including the following:

- Asbestos
- Fine PM (less than 2.5 µm)
- Acid gases (HF, HCl, HBr, Cl_2, Br_2)
- RCRA and CAA metals (Hg, Pb, As, Cr, Cd, Ni, Sb, Se, Ba, Be, Mn, Ag, Co)
- Polyhalogenated dibenzo-*p*-dioxins and furans (PCDD/PCDF, PBDD/PBDF, and mixed congeners)
- Co-planar polychlorinated biphenyls (PCBs)
- Polyaromatic hydrocarbons (PAHs)
- Semivolatile organic compounds (SVOCs)
- Volatile organic compounds (VOCs)
- Visible emissions (opacity)

Figure 4. Air Curtain Destructor

Balancing the needs for efficient and timely disposal of debris with the need to protect both the environment and human health presents a unique challenge. Information must be gathered on the types and relative quantities of potentially harmful emissions from ACDs burning both land-clearing (vegetative) and demolition debris. This information must be related where possible to the operational parameters used in the field in actual execution of the daily burn cycle. Additionally, recommendations on the conduct of the burns must be developed and must be condensed down to a simple set of actions easily conveyed to and conducted by the staff that will

operate the ACDs. In short, guidelines on how to operate the ACDs in a manner sufficient to minimize or eliminate harmful emissions must be developed.

To this end, the Air Pollution Prevention and Control Division (APPCD) of the United States Environmental Protection Agency's (EPA's) National Risk Management Research Laboratory (NRMRL) and the Decontamination and Consequence Management Division (DCMD) of the National Homeland Security Research Center (NHSRC) will oversee tests to be conducted under Task Order 72 of the STREAMS program (administered by EPA//Cincinnati, Ohio) by the RTI International/ARCADIS team to provide information on the emissions from ACDs during operation and to relate them where possible to operational parameters such as bed temperature, fuel type, fuel feed rate, etc. It must be noted that these tests are being coordinated within the Incident Command Structure (ICS) that has been set up at the site by Region 6 under the National Incident Management Structure (NIMS).

A6 – Project/Task Description

ARCADIS and EPA/ORD will conduct a field sampling campaign on an ACD located in the area surrounding New Orleans. The actual test location will depend upon proximity to available debris, adequate transportation and enough separation between the ACD and local populations. Access to the ACD is expected to be allowed for a period of approximately two weeks beginning around June 11, 2008. Overall testing will be comprised of three distinct groupings: 1) parametric testing with vegetative debris designed to both characterize the emissions from said waste and to evaluate operational parameters yielding the greatest chance of minimizing harmful emissions as judged by primarily continuous emission monitor measurements of CO and total hydrocarbons (THCs) and by bed temperature as measured by infrared pyrometer; 2) evaluation of emissions from burning "clean" C&D debris (material with no known asbestos material), and 3) evaluation of emissions from C&D debris that includes asbestos-containing materials. In each grouping, a representative portion of the exhaust gas from the combustion process will be sub-sampled and routed through ducting to allow stationary sampling for a variety of analytes using EPA protocols. Estimates of total mass emissions from the entire ACD will be calculated using both a direct ratio of the volume of gas sampled to the total volume of exhaust gas from the ACD and by a ratio of the sub-sampled analytes to the CO/CO_2 in the sampled volume and comparing to the total emission of CO/CO_2 determined by ORS. Because of the inherent variability likely to be seen in the waste feeds and combustor operation, it is anticipated that the limit on our ability to accurately estimate potential mass emission rates will be order of magnitude determinations.

A7 – Quality Objectives and Criteria

This project's main objective, to develop guidelines on how to operate the ACDs in a manner sufficient to minimize or eliminate harmful emissions, puts it into the method development project category, which is a QA Category III, however, this project is a high visibility project

with enforcement and regulatory implications, with data that will be used to perform a risk assessment, and will therefore adhere to QA Category II requirements where feasible including an on-site technical systems audit conducted by EPA QA staff. The ultimate decision to permit or prohibit the burning of C&D debris in ACDs is a policy decision and is beyond the scope of this project. The objective of this work is to provide objective and reliable data on the types and relative order of magnitude of emissions from the process. These data will then be used in the decision making process, including a risk assessment, coupled with estimates of relative risks associated with other alternative disposal methods.

The measurement protocols employed in this project are known to have a relatively high degree of accuracy and precision; however, the representativeness of the conditions tested, including the debris composition and condition, compared to normal daily operation over the lifetime of the cleanup program is unknown and largely unknowable. It is anticipated that the composition of the C&D debris will vary substantially with regard to the constituents of greatest concern (asbestos, lead, mercury, arsenic, and chlorine) and to the parameters of key importance to combustion effectiveness (energy and moisture content). Although the ACD operating conditions are likely to lie within a relatively consistent envelope, the composition of the debris is anticipated to vary significantly, leading to substantial variability in the range of emissions.

The critical measurement parameters necessary to adequately evaluate the most important environmental impacts of using ACDs for debris cleanup are as follows:

- Emission rate for asbestos, Hg, As, and Pb (significant risk drivers)
- Emission rate for CO_2/CO (necessary for estimation of total mass emission rate for other species)
- Emission rate for filterable PM (potential risk driver)
- Total sub-sampled flow rate (necessary for calculation of total mass emission rate for other species)
- Bed temperature (major parameter capable of routine measurement by ACD operators)
- Visible emissions (opacity)

For each set of test conditions (i.e., waste feed type), the range of measured values over all of the individual tests will be reported. Average values will also be reported, but their ultimate use may not adequately represent long-term emissions given the expected high variability associated with the waste. Subsequent use of these data must be done with the understanding that these tests are severely limited in scope. In many instances, it may well be appropriate to use worst-case emissions when estimating impacts.

Performance criteria for the individual critical measurements are summarized in Table 1. Due to expected variation in the feed/performance of the ACD, triplicate sampling runs (performed successively) will not yield a viable method precision estimate. Concurrent sampling runs are prohibited, in most cases, by a lack of sufficient sampling ports. Performance criteria for precision are therefore limited to one of the methods – VOCs by modified EPA Method 0040.

Table 1. Performance Criteria for Critical Measurements

Measurement Parameter	Sampling Method(s)	Sub – Parameter	Analysis Method	Acceptance Criteria (%Bias/Recovery)	Completeness
Sample and Velocity Traverses	EPA Method 1A (to be performed to select traverse points for M5/202, M23, and M29)	N/A	N/A	N/A	100%
Volumetric Flow Rate	EPA Method 2C (to be performed in conjunction with M5/202, M23, and M29)	Pitot tube leak check Gas temperature	Manometer K-Type thermocouple	± 10% of actual value ± 3ºF	100%
Moisture	EPA Method 4 (to be performed in conjunction with M5/202, M23, and M29)	Post-test meter calibration check	Standard Meter Comparison	± 0.5g of pre-calibration	100%
		Balance calibration check	Gravimetric S-Class weights	± 0.5g	N/A
CO_2/O_2	EPA Method 3A	Calibration error	Instrumental Calibration Gases	± 2%	90%
		Sampling system bias		± 5%	
		Zero & calibration drift		± 3%	
SO_2	EPA Method 6C	Calibration error	Instrumental Calibration Gases	± 2%	90%
		Sampling system bias		± 5%	
		Zero & calibration drift		±3%	
NO_X	EPA Method 7E	Calibration error	Instrumental Calibration Gases	± 2%	90%
		Sampling system bias		± 5%	
		Zero & calibration drift		± 3%	
Visible Emissions (opacity)	EPA Method 9	Reader is EPA Certified	N/A	N/A	100%
CO	EPA Method 10	Calibration error	Instrumental Calibration Gases	± 2%	90%

Measurement Parameter	Sampling Method(s)	Sub – Parameter	Analysis Method	Acceptance Criteria (%Bias/Recovery)	Completeness
Sample and Velocity Traverses	EPA Method 1A (to be performed to select traverse points for M5/202, M23, and M29)	N/A	N/A	N/A	100%
		Sampling system bias		± 5%	
		Zero & calibration drift		± 3%	
VOCs	Modified EPA Method 0040	N/A	EPA Method 0040	N/A	75% (minimum 6 of 8) Precision criteria is ± 10% using duplicates
Acid Gases	EPA Method 26	Post-test meter calibration check	Standard Meter Comparison	± 0.5g of pre-calibration	67% (minimum 4 of 6)
Total/Condensable Particulate	EPA Method 5/202	Post-test meter calibration check	Standard Meter Comparison	± 0.5g of pre-calibration	67% (minimum 4 of 6)
Metals	EPA Method 29	Laboratory QC Samples	EPA Method 29	± 25%	67% (minimum 4 of 6)
	N/A	calibration error	K-type	± 3ºF	100%
Asbestos	Modification of EPA Method 5 Using polycarbonate filter for sample collection – preliminary determination made in field based on PCM analyses, laboratory analyses by TEM	Post-test meter calibration check	Standard Meter Comparison	± 0.5g of pre-calibration	100%
Asbestos (Ash)	Composited Grab Samples – laboratory analyses by PCM, confirmation by TEM	N/A	EPA/600/R-93/116, July 1993	N/A	100%
ACD Bed Temperature (direct)	N/A	calibration error	K-type thermocouple	± 3ºF	100%
ACD Bed Temperature (remote)	N/A	Manufacturer's internal calibration check	Infrared pyrometer	± 10% of temperature range	100%

A8 – Special Training/Certification

The field crew will be issued copies of the site specific QAPP and copies of each method to be used in the field. They will be given detailed instructions on the specifics of collecting the samples/measurements for which they are responsible by the Field Team Leader. Training will be completed prior to their deployment in the field. No special certifications are required for the measurements for this project.

A9 – Documents and Records

All documentation, including log books, data files, email, and notes, will be maintained as part of the overall hurricane response effort, in addition to the usual data maintenance practices normally associated with data collection and analysis. A copy of each document will be made and provided to the Incident Command Structure following the completion of the test and reporting. A final report will be prepared to document the results of the study. The structure of the report has not been defined at this point, but will likely be composed of several volumes, each one focused on the specific aspect of the broader project. The volume for the ACD will include background, previous work, test approach, results, and conclusions.

SECTION B

DATA GENERATION AND ACQUISITION

B1 – Sampling Process Design (Experimental Design)

The testing will proceed from vegetative debris to C&D debris that does not contain any known asbestos ("clean" C&D debris) to C&D debris that has been verified to contain asbestos. The rationale for this approach is to verify that burning clean C&D debris does not generate any additional asbestos emissions, and to determine the emissions of asbestos from the combustion of asbestos-containing C&D debris. Preliminary evaluation of the ACD has shown that combustion of vegetative debris can be done with minimal emissions of visible PM. Vegetative debris has substantial energy content and allows good flow of air through the debris in the ACD, resulting in efficient and hot combustion. C&D debris will potentially have significantly lower energy content and is much less likely to provide clear air flow through the debris, thereby resulting in lower temperatures and a potential for incomplete combustion. The final addition of asbestos will determine how well the ACD can maintain temperatures high enough to convert chrysotile asbestos to forsterite across the entire ACD, which will be necessary to ensure that C&D debris can be burned in an ACD without resulting in harmful emissions of asbestos into the air.

In order to generate the maximum amount of data during the short period of time available, it is necessary to use an aggressive sampling approach that optimizes the potential for data collection. Preliminary scoping tests showed that the majority of the flow exiting the ACD appears to pass through a zone extending approximately 18 inches from the lip opposite the plenum side of the ACD across the entire length of the device. Figure 5 shows a flow distribution plot taken from the scoping tests. Preliminary data indicate that the variability the exhaust gas flow is minimal across the majority of the length of the device, possibly excluding either extreme end. Observations of the debris loading process showed that in normal operation, feeding occurs too frequently to practically allow removal of the flow extraction system on a regular basis during operation. Additionally, it would be impossible to return the flow extraction system to a sampling position and resume active sampling during the time period at which steady-state operation is interrupted by loading events (duration of approximately 1 minute or less). As it is likely that significant emissions beyond those experienced during steady-state operation occur during these transient "upsets" it is desirable to include these events in the time-integrated samples taken. For these reasons it is desirable to develop a flow extraction scheme that remains in place throughout the burn cycle. Furthermore, such a system must be capable of withstanding the likely occasional impact from debris being added to the ACD, as well as capable of withstanding the high heat present immediately over the burning bed.

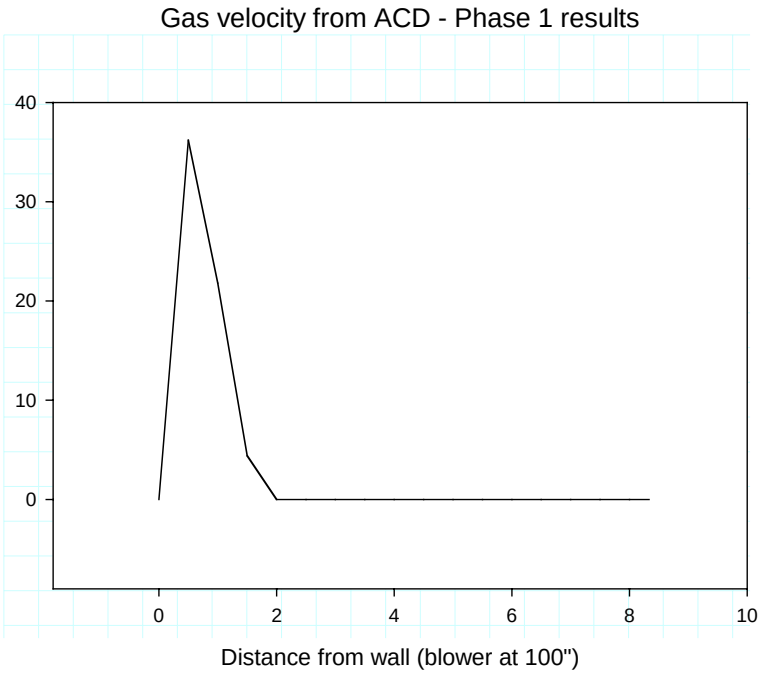


Figure 5. Velocity Profile across ACD from Scoping Tests

ARCADIS has constructed a heavy gauge steel "scoop" sampler that will be affixed to the ACD near the midpoint of the edge opposite the air plenum. The scoop will extend 18 inches over the face of the ACD, encompassing the previously measured zone of exhaust flow. Gases will flow through the scoop and into steel ducting before transitioning to a flexible insulated duct that will transfer the flow to ground level near the short side of the ACD opposite the mounted blower. The flex duct will then join a fixed, 6-in insulated duct suspended above ground on metal legs to allow access to extractive sampling trains. The 6-inch sampling duct is equipped with ports allowing multiple isokinetic sampling points free from flow perturbations (i.e., greater than 8 diameters between sampling points). A blower will be used to maintain flow balance sufficient to approximate as closely as possible isokinetic conditions at the scoop sampler. Figure 6 shows the sampling scheme, including the scoop arrangement.

Establishing isokinetic conditions in the sampling scoop is not well defined and will be performed with consultation among WA managers and the QA support staff. The currently planned methodology is as follows:

1.) Perform a confirmation check of the original flow profile with an s-type pitot and thermocouple when the unit is up to operating conditions
2.) Use the flow profile (calculated face velocities) of the scoop to calculate total volume entering the scoop, assuming 100% isokinetic conditions
3.) Set the blower flow rate for that value (corrected for fan conditions)

The flow profile will be taken with pitot/TC readings along a single 18" path from the wall toward the center of the unit (matching the scoop's 18" long side dimension where it will be installed). This will just be a spot check as it's difficult and dangerous to do depending on wind, and is expected to match the earlier data as seen in Figure 5. It will be assumed that the profile is continuous along the length of the ACD which allows us to apply those velocities to the scoop's 5" width. Applying to the scoop's total inlet area will allow calculation of total flow necessary to be "isokinetic" based on the average velocity. Note that in the best case the flow will be isokinetic only at the two points along the 18"' scoop length (ACD width) where the actual velocity matches the average velocity of the scoop inlet.

It may not be necessary to be that precise as long as it’s certain that the pump is not pulling in a lot of excess air - e.g., flow is way over isokinetic. That would show up as a drop in duct temperature, which will be monitored.

The individual sampler flows will be set for 100% isokinetic at the conditions existing in the sampling dust or stack in real time. We intend to assume the face velocities into the scoop are constant for the duration of the program.

Any deviations in the above procedures will be documented fully.

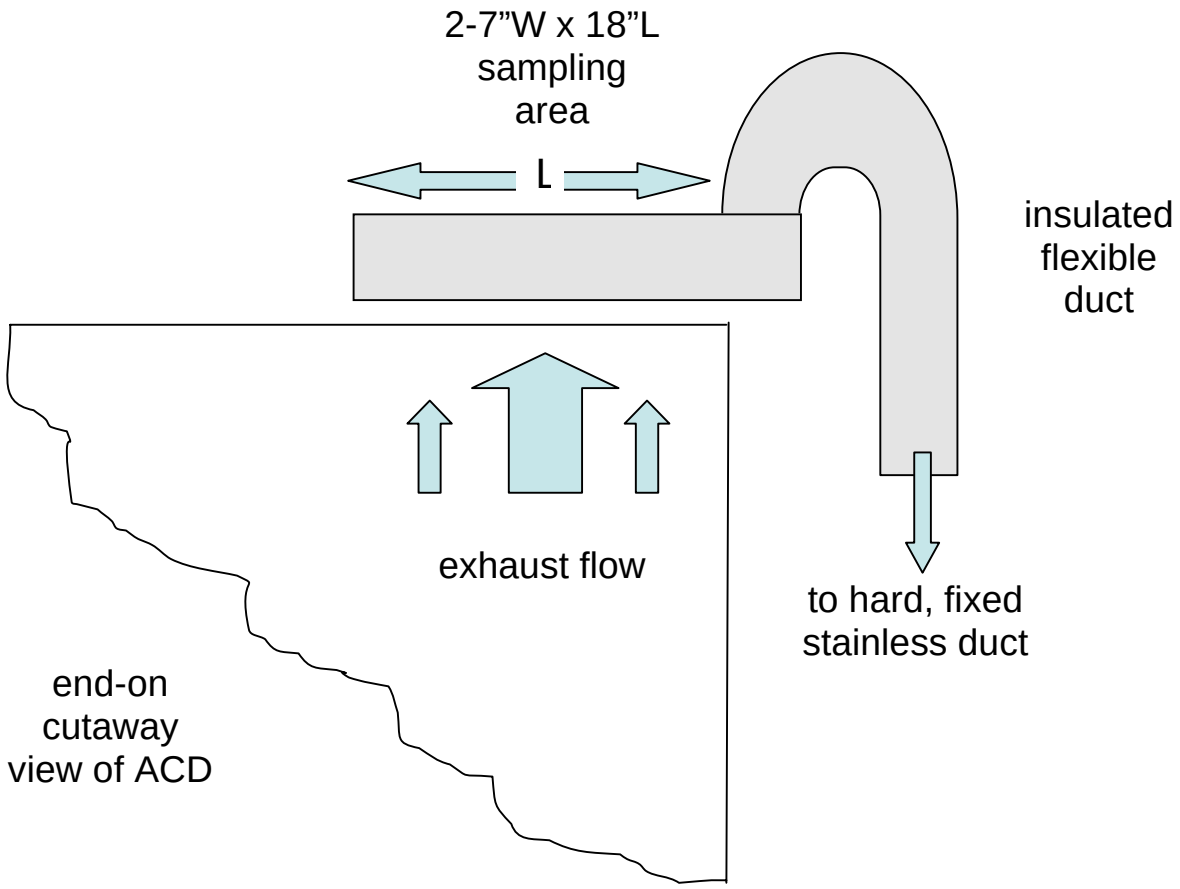


Figure 6. Sampling Scoop Diagram

Table 2 shows the anticipated sampling matrix. The numbers in the matrix represent the number of repetitions of each sampling methods to be performed. The matrix is designed to provide at least duplicate (and in most cases, triplicate) measurements for all groups of analytes under each set of run conditions (vegetative debris, clean debris, and asbestos-containing debris). This approach affords both the opportunity to have multiple measurements allowing conclusions to be drawn as regards the reproducibility of results and inherent variability of the process and further provides some redundancy in the event that a run day is lost due to conditions that preclude operation of the ACD (high winds, excessive rainfall) during the duration of the planned test event.

The ACD testing will be coordinated with perimeter ambient sampling for asbestos and other compounds. The critical measurement will be of asbestos content in the plume downwind of the ACD, and will be conducted under a separate QAPP. Measurements of metals will also be made at the same locations and compared to source concentrations measured under this test plan. Coordination for both asbestos and metals will focus on sampling start and stop times and qualitative visual evaluation of feed content as well as reporting of process upsets or unusual

events. The perimeter sampling report will be prepared separately, but will be reviewed by the broader test group (as will the ACD report).

Table 2. Anticipated Sampling Matrix

	Day	Date	CEM	T	Flows	VEs	PM/ Cond	PM size	Asbestos	Acid Gases	Dioxin/ PCB/ SVOC	Metals	VOC	Ash
Set-up	1	TBD												
Vegetative	2A	TBD	X	X	X	X								
Vegetative	2P	TBD	X	X	X	X								1
Clean C&D	3A		X	X	X	X	1	1		1	1	1	2	
Clean C&D	3P		X	X	X	X	1	1		1	1	1	2	1
Clean C&D	4A		X	X	X	X	1	1		1	1	1	2	
Asbestos C&D	4P		X	X	X	X	1	1	1	1	1	1	2	
Asbestos C&D	5A		X	X	X	X	1	1	1	1	1	1	2	
Asbestos C&D	5P		X	X	X	X	1	1	1	1	1	1	2	1
Breakdown/ packing	6													
Travel	7													

AM/PM	
Port 1	Flows
Port 2	Asbestos by modification to Method 5 (described in text)
Port 3	Hybrid Method 23; half for PCDD/PCDF, brominated D/F, PCBs and half for SVOC
Port 4	Metals by Method 29, Acid gases by M26A
Port 5	Total filterable/condensable PM by Method 5/202 (1.5 hours), then PM sizing by hybrid method (1.5 hours)
Non-isokinetic ports	CEMs, VOC by summa

B2 – Sampling Methods

B2.1 CEMs

Continuous instrumental methods will be employed via the use of continuous emissions monitors (CEMs) to measure concentrations of carbon dioxide (CO_2), oxygen (O_2), nitrogen oxides (NO_X), carbon monoxide (CO), sulfur dioxide (SO_2), and total hydrocarbons (THC). These instruments will be operated in accordance with EPA Methods 3A (CO_2/O_2), 7E (NO_X), 10 (CO), 6C (SO_2), and 25A (THC) as prescribed in 40 CFR Part 60, Appendix A. CEM testing will begin prior to test material being fed into the ACD and will continue for approximately two hours after last material is fed.

Effluent gas samples destined to the CEMs (except the THC monitor) will be conditioned to remove water vapor and particulate matter, which are interfering constituents. The sample gas going to the THC monitor will be heated and maintained at 250-300 ºF and filtered with glass fiber filters. The THC monitor requires the sample to be hot and condensate-free to operate properly, as some components of THC can be removed by condensation of water.

Components of the sampling system in contact with the sample gas are constructed of Type 316 stainless steel or Teflon® to minimize the possibility of surface chemical reactions, which can affect the accuracy of the measurements. The CO_2/O_2, NO_X, SO_2, THC, and CO sample collection and conditioning system consists of a heated probe and a particulate filter, followed by a moisture-removal trap and an out-of-stack secondary particulate filter. A sample pump (such as Thomas Model 2107CA 18-TFE) transports the effluent sample through a distribution manifold to the analyzers. The configuration of the sampling system allows the calibration gases to be injected either directly to the analyzers or through the complete sample collection and conditioning system.

An Environics Series 4000 Gas Mixer will be used to produce calibration gases at the desired concentration. The mixer achieves accurate blending/mixing by using four mass flow controllers and a computer control system. Based on EPA Method 205 procedures, the gas mixer blends a high-level EPA protocol 1 calibration gas of known concentration with an inert diluent gas such as nitrogen, thus producing a calibration gas at lower concentration.

The concentration signal outputs from the CEMs are connected to a computer-based data acquisition system (DAS). The DAS uses a portable computer and a strip chart recorder/analog-to-digital converter. In addition to providing an instantaneous display of analyzer response, the DAS compiles, averages, and saves analyzer data at a user-set frequency. For the purposes of these tests, the data will be logged with a one minute rolling average. The DAS integrates the real-time measurements and provides printouts of the averaged emissions over the desired time period. The functioning of the DAS will be checked by verifying that its indicated signal levels are in agreement with calibrated instruments such as digital voltmeters, TC readouts, etc. The data remain available for additional analyses after the tests are completed.

All pre-test and post-test calibration procedures are performed as outlined in the specific EPA methods. The operation principles of the analyzers are described in the following subsections. Analyzers with equivalent capability and performance may be substituted for the named models.

B2.2 CO_2/O_2 (EPA Method 3A)

Carbon dioxide and oxygen concentrations will be determined by **EPA Method 3A - Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)**, as described in 40 CFR Part 60, Appendix A. In Method 3A, a continuous gas sample is extracted from the stack and conveyed to instrumental analyzers for the determination of oxygen and carbon dioxide concentration. Results are used in the calculation of sampling duct gas molecular weight.

B2.3 SO_2 (EPA Method 6C)

Sulfur dioxide will be determined by **EPA Method 6C - Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)**, as described in 40 CFR Part 60, Appendix A. In Method 6C, a continuous gas sample is extracted from the sampling duct and conveyed to an instrumental analyzer (NDIR, UV, or fluorescence) for the determination of sulfur dioxide concentration. Flow data from concurrent EPA Methods 1A and 2C will be used to calculate sulfur dioxide mass emission rates.

B2.4 NO_X (EPA Method 7E)

Nitrogen oxides will be determined by **EPA Method 7E - Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)**, as described in 40 CFR Part 60, Appendix A. In Method 7E, a continuous gas sample is extracted from the sampling duct and conveyed to an instrumental analyzer (chemiluminescence) for the determination of nitrogen oxides concentration. Flow data from concurrent EPA Methods 1A and 2C will be used to calculate nitrogen oxides mass emission rates.

B2.5 CO (EPA Method 10)

CO emissions will be determined by **EPA Method 10 - Determination of Carbon Monoxide Emissions from Stationary Sources**, as described in 40 CFR Part 60, Appendix A. In Method 10, a continuous gas sample is extracted from the sampling duct and conveyed to an instrumental analyzer (NDIR or equivalent) for the determination of carbon monoxide concentration. Flow data from concurrent EPA Methods 1A and 2C will be used to calculate carbon monoxide mass emission rates.

B2.6 THC (EPA Method 25A)

EPA Method 25A - Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer is applicable over a wide range of THC concentrations, from percent levels down to low ppm levels. The method does not differentiate the species that constitute total hydrocarbons, i.e. methane and non-methane organic compounds (NMOCs) are measured together and reported as one concentration as equivalent propane. Method 25 is specifically

designed to measure NMOCs. However, it is not suitable for measuring concentrations that are less than 50 ppm and will not be used.

In Method 25A, a gas sample is extracted from the source through a heated sample line, if necessary, and a glass fiber filter; it is then introduced to a flame ionization analyzer. Results are reported as volume concentration equivalents (ppm by volume) of the calibration gas (propane) or as carbon equivalents. The mass emission rate is calculated by the incorporation of results of EPA Methods 1A and 2C volumetric flow data along with moisture and molecular weights determined by EPA Methods 3A and 4.

B2.7 Temperature

Temperature in the ACD bed area will be determined using two methods. K-type thermocouples will be inserted through joints in the refractory lining at as-yet-to-be-determined locations depending on accessibility of the specific unit used in the tests. These thermocouples will serve to provide wall temperatures during the burn cycle. Additionally, bed temperature will be determined using infrared pyrometry. Each temperature measurement by pyrometry will be recorded in notebooks along with a visual representation of the bed location sampled. Attempts will be made to manually place a K-type thermocouple into the bed at the site of the infrared measurement to provide correlative data between the two measurement techniques. The ultimate objective in temperature measurement is not to ascertain a "true" temperature; rather the goal is to determine a readily reproducible temperature parameter that can potentially be used by inspectors and operators to monitor ACD performance.

B2.8 Flue Gas Volumetric Flow Rate (EPA Methods 1A & 2C)

Flue gas volumetric flow rates will be determined by **EPA Method 1A - Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts and EPA Method 2C – Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks and Ducts (Standard Pitot Tube)**, as described in 40 CFR Part 60, Appendix A. A measurement location in the effluent stream is selected to minimize angular and cyclonic flow. Using Method 1A, the duct cross section is divided into an appropriate number of equal areas and the probe is marked to signify the velocity traverse points. Due to the potential for flow disturbance in small stacks, the sample extraction and flow measurement are performed apart from one another. Sampling ports for extractive samples are located eight equivalent diameters upstream of the velocity sampling ports to allow for the re-establishment of flow stability. Using Method 2C, a traverse for velocity head and sampling duct gas temperature is performed using a standard pitot tube and thermocouple probe to minimize flow disturbance. Sampling duct gas volumetric flow rate is calculated by use of the resultant data, the sampling duct gas density, and duct cross sectional area. Measurements will be performed in conjunction with each test run for filterable/condensable particulate, metals, and dioxins/furans. Flow data, along with pollutant concentration data from concurrent methods will be used to calculate pollutant mass emission rates.

Prior to sampling, the ACD exhaust velocity will be measured at the sampling scoop location using an S Type pitot tube and thermocouple probe to establish set points for the sampling apparatus. The sampling scoop nozzle cross sectional area and the sampling duct volumetric flow rate will be adjusted to establish isokinetic sampling at the scoop while maintaining the duct velocity within the desired range.

B2.9 Stack Gas Molecular Weight and Stack Moisture (EPA Methods 3A & 4)

Sampling duct gas molecular weight and diluent concentration will be determined by **EPA Method 3A - Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure) and EPA Method 4 - Determination of Moisture Content in Stack Gases**, as described in 40 CFR Part 60, Appendix A. In Method 3A, a gas sample is continuously extracted from the sampling duct and conveyed to instrumental analyzers for the determination of O_2 and CO_2 concentration. Diluent gas concentration and molecular weight are calculated from these results. In Method 4, a gas sample is extracted from the source with moisture being removed and determined gravimetrically and/or volumetrically. Method 4 samples will be taken as a part of the EPA Method 5/202, M29, and M23 samples.

B2.10 Filterable/Condensable Particulate Matter (EPA Method 5/202)

Filterable particulate matter sampling will be performed according to **EPA Method 5 - Determination of Particulate Emissions from Stationary Sources**, as described in 40 CFR Part 60, Appendix A and **EPA Method 202 – Determination of Condensible Particulate Emissions from Stationary Sources**, as described in 40 CFR Part 51, Appendix M. A flue gas sample is withdrawn from the sampling duct isokinetically through a heated probe and pre-weighed, heated, glass fiber filter into an impinger/condenser train. The filtered, dried gas is measured with a calibrated dry gas meter and the particulate matter captured in the probe and filter are desiccated and weighed. In Method 202, the original charge and the condensate from the impingers is extracted with methylene chloride and that extract, along with the residual water, is dried to a constant weight. These residues represent, respectively, the condensable organic particulate and condensable inorganic particulate fractions. Filterable/condensable particulate emission rates are calculated from the resultant particulate concentrations and the results of flue gas volumetric flow rate measurements using concurrent EPA Methods 1A and 2C measurements. Neither N_2 purging for dissolved SO_2 removal or NH_4OH addition for sulfate correction will be used due to the fact that little or no SO_2 is expected. Also, condensable organics are of interest and our experience with the sulfate correction procedure has shown overcorrection (i.e., negative values).

B2.11 Asbestos

No approved method for measuring asbestos in combustion flue gases currently exists. We will be pulling a sample isokinetically from the sampling duct through a 47 or 83 mm diameter MCE or polycarbonate filter with a 0.4µm pore size at approximately 15 slm. The samples will be drawn with or without a dilution probe depending on judgements made on site. It will be necessary to perform a preliminary test to determine the correct sampling time to load the filters

with an amount of sample appropriate to the ultimate asbestos analysis methodology - Transmission Electron Microscopy (TEM) according to the method of the International Organization for Standardization, "Ambient Air – Determination of Asbestos Fibres – Direct-transfer Transmission Electron Microscopy Method", ISO 10312. The analysis report will include fiber type, length, and width. The preliminary test runs will be taken for the following approximate durations: one minute, three minutes, five minutes, ten minutes, and thirty minutes. The filters from the preliminary runs will be subjected to visible examination and phase contrast microscopy (PCM) on site. This technique, NIOSH Method 7400, is expected to be capable of determining if a given filter is properly loaded for subsequent TEM analyses. This procedure has been used for this purpose to date only with ambient filters and may suffer from interference problems with the exhaust from the ACD. Possible use of the dilution probe may mitigate the interference problem. A third alternative sampling strategy will be to collect asbestos samples in a water-filled impinger for later re-suspension prior to analysis. All asbestos sampling contingencies will be evaluated and documented on site with the intention of selecting the one that yields the most useful results. Several sampling methodologies may have to be used in that process. The QA Officer will be consulted prior to major decisions concerning selection of a method or methods.

The filters will be maintained at a temperature suitable for preventing condensation from forming by using a temperature controlled hotbox. Samples will be shipped to Bureau Veritas which is accredited under the National Institute of Standards and Technology's (NIST) National Voluntary Laboratory Accreditation Program (NVLAP) for TEM analysis by ISO 10312. RTI International, which administers NIST's NVLAP for TEM analysis, will analyze a subset of approximately 10% of the samples for QA purposes.

It is acknowledged that this proposed methodology is untried and unproven. Simultaneous ambient monitoring of asbestos using more rigorously developed methodologies (outside the parameters of this QAPP and conducted by the Sustainable Technology Division of EPA/NRMRL) will provide a more direct evaluation of the combined risk associated with asbestos from both combustion emissions and fugitive emissions from debris handling. The sampling duct sample will be evaluated for its potential to determine the presence or absence of harmful asbestos forms. If successful, this approach will allow us to determine whether the combustion process is able to achieve chrysotile transformation using thermal processing in an ACD.

B2.12 HF, HCl, Cl_2, HBr, and Br_2 (EPA Method 26)

HF, HCl, Cl_2, HBr, and Br_2 emission rates will be determined by **EPA Method 26 - Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources (Non-Isokinetic Method)**, as described in 40 CFR Part 60, Appendix A. An integrated sample is extracted from the source and passed through a pre-purged heated probe and filter into dilute sulfuric acid and dilute sodium hydroxide solutions which collect the gaseous hydrogen halides and halogens, respectively. The filter collects particulate matter including halide salts but is not routinely recovered and analyzed. The hydrogen halides are solubilized in the acidic solution and form chloride (Cl^-), bromide (Br^-), and fluoride (F^-) ions. The halogens have a very low solubility

in the acidic solution and pass through to the alkaline solution where they are hydrolyzed to form a proton (H^+), the halide ion, and the hypohalous acid (HClO or HBrO). Sodium thiosulfate is added in excess to the alkaline solution to assure reaction with the hypohalous acid to form a second halide ion such that 2 halide ions are formed for each molecule of halogen gas. The halide ions in the separate solutions are measured by ion chromatography (IC). Emission rates are calculated from these results and the results of concurrent flue gas flow rate measurements using EPA Methods 1A and 2C.

B2.13 Dioxins/Furans, PCBs, PAHs, and SVOCs (EPA Method 23/EPA Method 0010)

Semivolatile organic compound emission rates, including chlorinated PCDD/F, mixed bromo-chloro dioxins and furans, coplanar PCBs, and PAHs will be determined by the use of **EPA Method 23 - Determination of Polychlorinated Dibenzo-P-Dioxins and Polychlorinated Dibenzofurans from Stationary Sources**, and **EPA Method 0010 – Modified Method 5 Sampling Train** as described in 40 CFR Part 60, Appendix A. A metered flue gas sample is isokinetically withdrawn from the sampling duct through a heated probe and Teflon coated, glass fiber filter onto a condenser/XAD-2 packed resin trap for collection of dioxins/furans. The filtered, dried gas is measured with a calibrated dry gas meter. The XAD resin trap is extracted, split, and analyzed for a variety of compounds by high resolution gas chromatography/ high resolution mass spectrometry (HRGC/HRMS). Emission rates are calculated from these results and the results of concurrent flue gas flow rate measurements using EPA Methods 1A and 2C.

B2.14 Metals (EPA Method 29)

Metals emission rates will be determined by the use of **EPA Method 29 - Determination of Metals Emissions from Stationary Sources**, as described in 40 CFR Part 60, Appendix A. A metered flue gas sample is withdrawn isokinetically from the sampling duct through a heated probe and glass fiber filter into an impinger/condenser train. The impingers contain a mixture of 5% nitric/10% hydrogen peroxide for metals absorption. Mercury is further absorbed by impingers containing 4% potassium permanganate/10% sulfuric acid. The filtered, dried, metals depleted gas is measured with a calibrated dry gas meter. The filter and impinger solutions are digested and analyzed for the target metals by ICAP. Metals emission rates are calculated from the resultant metals concentrations and the results of flue gas volumetric flow rate measurements using concurrent EPA Methods 1A and 2C measurements.

B2.15 VOCs (Modified EPA Method 0040)

Concentrations of volatile organic compounds (VOCs) will be determined by an adapted version of **EPA Method 0040 – Sampling of Principal Organic Hazardous Constituents from Combustion Sources Using Tedlar Bags**. In Method 0040, a representative sample is drawn from a source through a heated sample probe and filter. The sample then passes through a heated 3-way valve into a condenser where the moisture and condensable components are removed from the gas stream and collected in a glass trap. The gas sample is then collected in a canister.

The adaptation to be used here substitutes a SUMMA®-passivated canister for the Tedlar bag. This modification is necessitated by the fact that the site will be in a location that may require the samples to be air-shipped to the laboratories. Tedlar bags are prone to burst during air transport. SUMMA® canisters, which are routinely used in ambient sampling methods for organics, are an acceptable substitution to solve this problem. VOC mass emission rates are calculated from the resultant constituent VOC concentrations and the results of flue gas volumetric flow rate measurements using concurrent EPA Methods 1A and 2C.

B2.16 Particle Sizing Using Modified California Air Resources Board Method 501

Detailed particle size determination will involve the modification of California ARB Method 501. In CARB Method 501, an in-stack PM_{10} particle separation device (a cyclone) is used to determine the concentration of PM_{10} particulate matter. The sampling duct gas then passes to an Andersen 10-stage cascade particle sizing impactor for further sub-PM_{10} size determination. This procedure will yield PM_{10} concentration (from the PM_{10} cyclone) and a distribution of sub-PM_{10} particulate (from the Andersen cascade impactor).

B2.17 PM2.5 Using Modified EPA Method 201A

$PM_{2.5}$ particulate determinations will be by a modified version of **EPA Method 201A - DETERMINATION OF PM_{10} EMISSIONS (Constant Sampling Rate Procedure)**. In this method, a gas sample is extracted at a constant flow rate through an in-stack sizing device, which separates PM greater than $PM_{10.}$ Variations from isokinetic sampling conditions are maintained within well-defined limits. The particulate mass is determined gravimetrically after removal of uncombined water. The modification to be employed involves substituting a $PM_{2.5}$ cyclone for the PM_{10} cyclone normally used in this method. The two devices are designed to characterize their respective particulate fractions at the same flow rate, which allows this modification to be made.

B2.18 Ash Sampling

Samples of bulk ash will be collected following each of the three phases of testing (vegetative, clean C&D, asbestos C&D) on the morning following conclusion of testing. Prior experience has indicated that the ash will not be cooled to ambient temperatures, so care must be taken in obtaining samples. Multiple samples will be taken from randomly selected portions of the ash bed using a metal scoop, then placed in a stainless steel container for cooling. The actual number of samples per test condition will be determined by ash bed accessibility, and samples will be collected from the same locations for each condition to the extent possible. At least one composited sample, consisting of sub-samples from several parts of the ACD ash bed (e.g., middle, corner, several depths) will be collected for the three fuel types. The composited sample will then be sub-sampled and sent to the analytical laboratory for the Toxicity Characteristic Leaching Procedure (TCLP). Additional samples will be provided to Bureau Veritas for evaluation of asbestos content.

B2.19 Visible Emissions

Visible emissions (opacity) from the ACD will be monitored and recorded by the use of **EPA Method 9 – Visual Determination of the Opacity of Emissions from Stationary Sources**, as described in 40 CFR Part 60, Appendix A. In this method, the opacity of emissions is determined visually by an EPA certified observer (smoke reader).

B3 – Sample Handling and Custody

Due to the number of samples that will be generated during the field tests, a sample custodian (Charly King) will be assigned the responsibility to ensure that all samples are properly identified, recorded, packaged, and shipped. Samples will be packaged, transported and stored according to procedures specified in the standard methods. If no procedures are specified, samples will be packaged upright and shipped in coolers to the analytical laboratory. All samples will be shipped with the appropriate chain-of-custody information. When hold times are critical, they are typically specified in the analytical method. Analytical laboratories will be held to the method specified hold-times. Table 3 lists the specified sample containers, handling and preservation, laboratories, and the respective sampling run and hold times for the various samples.

Table 3. Sample Storage, Handling and Hold Times

Sample Type	Method Sampling/ Analysis	Sampling Time (min)/ Volume(Liter)	Sample Container	Special Handling/ Preservation	Analytical Laboratory	Maximum Hold Time
Metals	M29/6020	60 min ~1000 L	Polyethylene bottles/ Teflon-lined caps	Vent caps containing KMnO4; Keep samples at 4°C.	STL	14 days
Acid Gases	M26	60 min ~60 L	Polyethylene bottles/ Teflon-lined caps	None	STL	4 weeks
Dioxins/furans /PCBs/SVOC	M23/0010 HRGC/HRMS	180 min ~3000 L	Clear or amber glass/ Teflon-lined caps; XAD cartridges	Samples (excluding particulate filter) stored at 4°C	Analytical Perspectives	Extracted within 14 days of receipt; Analyzed within 40 days of extraction
VOCs	M0040/TO-15	~30 min	SUMMA canisters	Pre-cleaned canisters.	STL	30 days
Asbestos	Polycarbonate Filter Collection/TEM	Approx. 10-30 min 150-450 L	Polystyrene Petri Dishes	None	Bureau Veritas	Unlimited
Asbestos (Ash)	Grab samples Composited/ EPA/600/R-93/116, July 1993	15 min	Clear or amber glass/ Teflon-lined caps	None	Bureau Veritas	Unlimited

Each sample will be assigned a unique identification number according to the following format:

Site Code&Sample Type Code&Run Number&QC Code (if applicable), where "&" indicates concatenation.

Site Codes

The site code for sampling of the air curtain destructor is: ACD

Sample Type Codes

PM =	filterable/condensable particulate matter (filter, rinse)
PM10=	PM_{10} particulate
PM2.5=	$PM_{2.5}$ particulate
PS=	particle size (Petri dishes)
ASB =	asbestos
M29 =	metals
M40 =	VOCs
M26 =	acid gases (HF, HCl, Cl2, HBr, Br2)
M23 =	dioxins/furans/PCBs/SVOCs
ASH=	Ash samples

Run Number

Run Numbers are sequential 01, 02, 03, etc. Dates samples are taken will be entered on data sheets and in the project notebook but not be incorporated in to the sample ID.

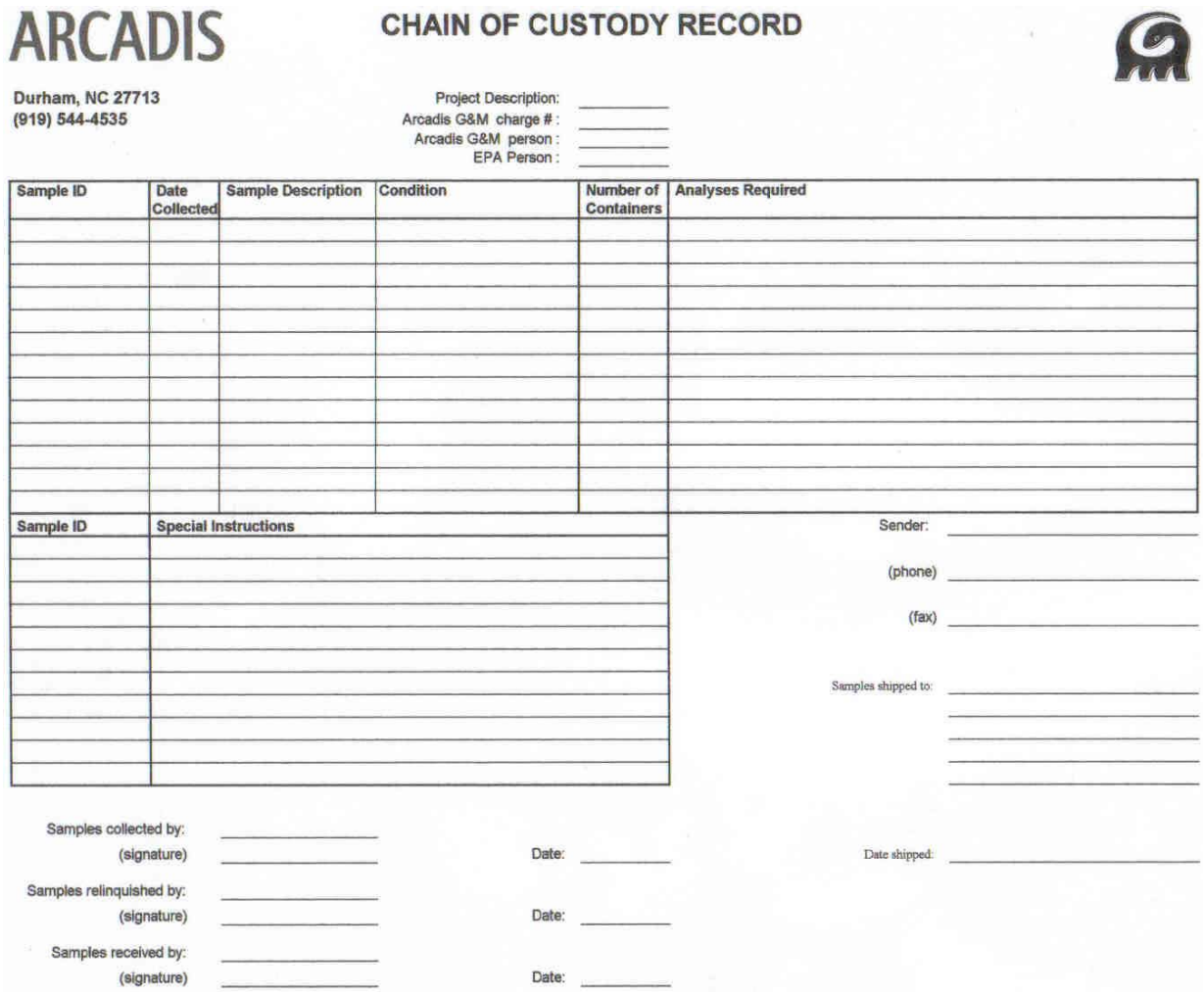
QC Codes

DUP = duplicate or co-located sample
FB = field blank
RB = reagent blank
SP = spiked train

An example sample code for the first metals sample taken would be:

ACD-M29-01

Custody sheets will be completed for all samples generated. Forms will accompany samples at all times and be signed by responsible parties upon receipt. It is the responsibility of the Sample Custodian to ensure that chain-of-custody forms are completed for every sample and that they accompany samples to the appropriate laboratory for analysis. Copies of the completed custody forms for all samples will be maintained by the Sample Custodian. Figure 7 shows a sample Chain-of-Custody form.



ARCADIS

CHAIN OF CUSTODY RECORD

Durham, NC 27713
(919) 544-4535

Project Description: _____
Arcadis G&M charge # : _____
Arcadis G&M person : _____
EPA Person : _____

Sample ID	Date Collected	Sample Description	Condition	Number of Containers	Analyses Required

Sample ID	Special Instructions

Sender: _____

(phone) _____

(fax) _____

Samples shipped to: _____

Samples collected by: _____
(signature) _____ Date: _____

Samples relinquished by: _____
(signature) _____ Date: _____

Samples received by: _____
(signature) _____ Date: _____

Date shipped: _____

Figure 7. Chain-of-Custody Form

B4 – Analytical Methods

B4.1 Fluorides, Chlorides and Bromides

Samples analyzed by Resolution Analytics using ion chromatography as described in EPA **Method 26** ***Determination of Hydrogen Halide and Hydrogen Emissions from Stationary Sources***.

B4.2 Dioxins/Furans, PCBs, and SVOCs

Samples collected using Method 23/0010 will be analyzed for dioxins and furans by Analytical Perspectives according to EPA/SW846 **Method 8290** ***Polychlorinated Dibenzodioxins (PCDDs)***

and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS). The analysis for PCBs will be by EPA Method 1668A.

The sample will contain a filter, an XAD cartridge, rinses of methylene chloride/methanol and toluene/acetone (acetone optional) as well as aqueous impinger contents. The methylene chloride/methanol rinse will be extracted with pH 2 water/hydrochloric acid. The water will then be re-extracted with methylene chloride twice. The three methylene chloride extracts will be combined and used in the extraction of the remaining components. The XAD and filter will be soxhlet-extracted with methylene chloride after spiking with internal standards as required pre-extraction. The methylene chloride from the rinse will be used in this extraction and it should be poured through the soxhlet thimble to catch any particulate that was in the rinse. The methylene chloride from this extraction will be collected and concentrated to final volume. After the methylene chloride extraction a second extraction with toluene will be done. The toluene rinses are to be added to the thimble at this stage. A Dean-Stark apparatus will be used to collect the acetone/ methylene chloride and water that are still in the sample. The toluene extract will be concentrated to final volume. The impinger solution should be acidified to pH2 and extracted with methylene chloride. This extract should be concentrated to final volume.

From these extracts the semi-volatile analyses is normally performed on a portion of the methylene chloride extract. The impinger extract is analyzed for phenols. The dioxin analysis clean-up will require equal portions of the methylene chloride and toluene extracts from the XAD and Filter. Table 4 shows the target semi-volatile organic compounds, along with estimated detection limits.

Table 4. Target SVOCs

Compound	Reporting Limit (µg)
Phenol	5.0
Bis (2-chloroethyl) ether	1.0
2-Chlorophenol	5.0
1,3-Dichlorobenzene	1.0
1,4-Dichlorobenzene	1.0
1,2-Dichlorobenzene	1.0
2-Methylphenol (o-cresol)	5.0
Bis (2-chloroisopropyl) ether	1.0
N-nitroso-di-n-propylamine	1.0
4-Methylphenol	5.0
Hexachloroethane	1.0
Nitrobenzene	1.0
Isophorone	1.0
2-Nitrophenol	5.0
2,4-Dimethylphenol	5.0
Benzoic acid	30
Bis (2-chloroethyoxy) methane	1.0
2,4-Dichlorophenol	5.0

Compound	Reporting Limit (µg)
1,2,4-Trichlorobenzene	1.0
Naphthalene	1.0
4-Chloroaniline	10
Hexachlorobutadiene	1.0
4-Chloro-3-methylphenol	5.0
2-Methylnaphthalene	1.0
Hexachlorocyclopentadiene	20
2,4,6-Trichlorophenol	5.0
2,4,5-Trichlorophenol	5.0
2-Chloronaphthalene	1.0
2-Nitroaniline	10
Dimethylphthalate	5.0
Acenaphthylene	1.0
2,6-Dinitrotoluene	5.0
3-Nitroaniline	10
Acenaphthene	1.0
2-4-Dinitrophenol	20
4-Nitrophenol	20
2,4-Dinitrotoluene	5.0
Dibenzofuran	1.0
Diethylphthalate	5.0
Fluorene	1.0
4-Chlorophenyl-phenyl ether	1.0
4-Nitroaniline	10
4,6-Dinitro-2-methylphenol	10
N-Nitrosodiphenylamine	10
4-Bromophenyl-phenyl ether	1.0
Hexachlorobenzene	1.0
Pentachlorophenol	20
Phenanthrene	1.0
Anthracene	1.0
di-n-Butylphthalate	5.0
Fluoranthene	1.0
Pyrene	1.0
Butylbenzylphthalate	5.0
3,3'-Dichlorobenzidine	20
Chrysene	1.0
Benzo(a)anthracene	1.0
Bis (2-ethylhexyl)phthalate	5.0
di-n-Octylphthalate	5.0
Benzo(b)fluoranthene	1.0
Benzo(k)fluoranthene	1.0
Benzo(a)pyrene	1.0
Indeno(1,2,3-c-d)pyrene	1.0
Dibenz(a,h)anthracene	1.0
Benzo(q,h,i)perylene	1.0

B4.3 Metals

The filter and the peroxide impinger solutions are digested and analyzed for the target metals by EPA/SW846 **Method 6020-** ***Inductively Coupled Argon Plasma Emission Spectroscopy with Mass Spectroscopy (ICAP/MS)***. The analytical laboratory is First Analytical. Metals tested include RCRA and CAA metals as follows:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Lead
- Manganese
- Mercury
- Nickel
- Selenium
- Silver

B4.4 VOCs Modified Method 0040

Analysis of VOCs will be done by RTP Laboratories using EPA Method TO-15, ***Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS) as seen in the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA 625/R-96/010b)***. Target compounds, along with method detection limits as reported by STL, are shown in Table 5.

Table 5. Target VOCs

Compound	RL	Units	MDL	Units
Benzene	0.2	ppb(v/v)	0.085	ppb(v/v)
Benzyl chloride	0.2	ppb(v/v)	0.077	ppb(v/v)
Bromomethane	0.2	ppb(v/v)	0.066	ppb(v/v)
Carbon tetrachloride	0.2	ppb(v/v)	0.083	ppb(v/v)
Chlorobenzene	0.2	ppb(v/v)	0.071	ppb(v/v)
Chloroethane	0.2	ppb(v/v)	0.066	ppb(v/v)
Chloroform	0.2	ppb(v/v)	0.062	ppb(v/v)
Chloromethane	0.5	ppb(v/v)	0.051	ppb(v/v)
1,2-Dibromoethane (EDB)	0.2	ppb(v/v)	0.076	ppb(v/v)
1,2-Dichlorobenzene	0.2	ppb(v/v)	0.083	ppb(v/v)
1,3-Dichlorobenzene	0.2	ppb(v/v)	0.083	ppb(v/v)
1,4-Dichlorobenzene	0.2	ppb(v/v)	0.087	ppb(v/v)
Dichlorodifluoromethane	0.2	ppb(v/v)	0.062	ppb(v/v)
1,1-Dichloroethane	0.2	ppb(v/v)	0.075	ppb(v/v)

Compound	RL	Units	MDL	Units
1,2-Dichloroethane	0.2	ppb(v/v)	0.062	ppb(v/v)
cis-1,2-Dichloroethene	0.2	ppb(v/v)	0.081	ppb(v/v)
1,1-Dichloroethene	0.2	ppb(v/v)	0.06	ppb(v/v)
1,2-Dichloropropane	0.2	ppb(v/v)	0.07	ppb(v/v)
cis-1,3-Dichloropropene	0.2	ppb(v/v)	0.066	ppb(v/v)
Trans-1,3-Dichloropropene	0.2	ppb(v/v)	0.065	ppb(v/v)
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.2	ppb(v/v)	0.069	ppb(v/v)
Ethylbenzene	0.2	ppb(v/v)	0.081	ppb(v/v)
Hexachlorobutadiene	1	ppb(v/v)	0.088	ppb(v/v)
Methylene chloride	0.5	ppb(v/v)	0.06	ppb(v/v)
Styrene	0.2	ppb(v/v)	0.083	ppb(v/v)
1,1,2,2-Tetrachloroethane	0.2	ppb(v/v)	0.077	ppb(v/v)
Tetrachloroethene	0.2	ppb(v/v)	0.085	ppb(v/v)
Toluene	0.2	ppb(v/v)	0.072	ppb(v/v)
1,2,4-Trichlorobenzene	1	ppb(v/v)	0.098	ppb(v/v)
1,1,1-Trichloroethane	0.2	ppb(v/v)	0.062	ppb(v/v)
1,1,2-Trichloroethane	0.2	ppb(v/v)	0.083	ppb(v/v)
Trichloroethene	0.2	ppb(v/v)	0.064	ppb(v/v)
Trichlorofluoromethane	0.2	ppb(v/v)	0.068	ppb(v/v)
1,1,2-Trichloro-1,2,2-trifluoroethane	0.2	ppb(v/v)	0.074	ppb(v/v)
1,2,4-Trimethylbenzene	0.2	ppb(v/v)	0.081	ppb(v/v)
1,3,5-Trimethylbenzene	0.2	ppb(v/v)	0.074	ppb(v/v)
Vinyl chloride	0.2	ppb(v/v)	0.048	ppb(v/v)
m-Xylene & p-Xylene	0.2	ppb(v/v)	0.068	ppb(v/v)
o-Xylene	0.2	ppb(v/v)	0.072	ppb(v/v)

B4.5 TCLP

Ash samples will be subjected to the TCLP (SW-846 Method 1311). The selection of laboratory(s) for this set of analyses is ongoing. Most likely to be used is the EPA Region 6 Laboratory as they conduct these analyses on a routine basis. Analysis for RCRA and CAA metals will be conducted on the extracts.

B4.6 Asbestos

Particulate matter collected from the sampling duct on polycarbonate filters will be analyzed by Bureau Veritas according to the method of the ***International Organization for Standardization,***

"Ambient Air – Determination of Asbestos Fibres – Direct-transfer Transmission Electron Microscopy Method", ISO 10312. TEM by will be used to determine the presence or absence of asbestos. Thermal degradation products of crysotile such as forsterite and "forsterite-like" materials may be identified using fiber morphology crystal structure as determined by selected area electron diffraction, and chemistry as determined by energy dispersive spectroscopy (X-ray spectroscopy). Optical properties of the degradatiojn products as determined by polarized light microscopy (PLM) may also be useful for determining forsterite-like materials. It is intended that an ultimate judgment of "not crysotile" will result from analytical technique.

Samples will be preliminarily analyzed in the field by PCM to determine fitness for the later TEM analyses.

If particulate loading problems (e.g., soot to asbestos ratio, overall high or low loading) prevent use of the polycarbonate filter for asbestos collection, consideration will be given to removing the filter and collecting the asbestos directly in the distilled water-filled impingers**.** It is not known if successful analyses of such water samples can be carried out.

B4.7 Asbestos in Ash

Ash samples collected at various levels and parts of the ACD floor will be analyzed by techniques of ***EPA/600/R-93/116, July 1993***. PLM will be used for screening analysis of the ash but if none is found, the negative result will be confirmed by TEM. The same identification methodology used with the stack samples will be used in case of non-negative results.

B5 – Quality Control

One field blank will be done for each of the following sampling procedures:

- Asbestos (modification to Method 5)
- Acid gases (Method 26)
- Dioxins/Furans/PCBs/SVOCs (Methods 23/0010)
- Metals (Method 29)
- Filterable/condensable particulate matter (Method 5/202)

The field blanks will be prepared, taken to the sampling locations, and leak checked like all other sampling trains. They will then be recovered in the normal way and submitted to the laboratory. Most samples will be taken in triplicate; exceptions are the ash samples. They will be split for submittal to the laboratories for asbestos and TCLP analyses. EPA Method 23 XAD absorbent traps will be pre-spiked in the laboratory with selected materials for recovery assessment purposes. All QC protocols inherent in the cited methods will be followed.

B6 – Instrument/Equipment Testing, Inspection, and Maintenance

Equipment used in the field is calibrated by the manufacturer and/or calibration-checked in-house prior to use. Calibration of the equipment is verified when the equipment is returned to ARCADIS' offices after a test campaign is complete. Method 5 meter boxes are calibrated prior to field use and calibration checked after field use using procedures in the method. The pre- and post-test checks must agree within the range stated in Method 5 for data to be considered acceptable. ARCADIS maintains historical calibration/inspection data for meter boxes, as well as nozzles, thermocouples, and pitots in a central location at its RTP offices. Records of field calibrations (i.e., CEMS instrument calibrations) are kept in a laboratory notebook by the CEMS engineer. The Field Team Leader maintains certificates of calibration for each instrument. Maintenance records of equipment adjustments or repairs are kept in bound project notebooks. These records include the date and description of the maintenance performed. Where possible, replacement equipment will be kept on hand in case of equipment difficulties. Equipment will be repaired and/or replaced when possible if malfunctions occur.

B7 – Instrument/Equipment Calibration and Frequency

The Field Team Leader tracks the calibration expiration dates of field instruments requiring annual manufacturer calibration using a spreadsheet. The Field Team Leader ensures that calibrations are kept up to date. Instrument calibrations are performed in the field as required by the methods being used or according to manufacturer's suggestions.

B8 – Inspection/Acceptance of Supplies and Consumables

Consumables and supplies ordered by ARCADIS are inspected by the Receiving Department personnel at the time of receipt and checked for accuracy and damages to the shipment. Damaged goods are rejected and returned to the supplier.

B9 – Other Measurements

ARCADIS will receive input of several data fields considered pertinent, but not critical, from third-party organizations. Included in these measurements are the following:

- Debris makeup will be evaluated qualitatively. We will attempt to collect any information available on the makeup of debris tested, including collection location, gross makeup, water content (or amount of water added for particulate and asbestos control), and gross weight as estimated by the ACD operator. Sources of these data will likely include state and local officials in addition to the ACD contractor. Any scale used in the estimation of the gross weight of debris will not be calibrated as part of this work assignment. Visual records from digital photographs will provide additional qualitative information on debris composition.

- Ambient measurements of meteorological conditions (temperature, relative humidity, wind direction and speed), and values reported from localized monitors for PM and asbestos. These data will be obtained from NRMRL/STD.
- Perimeter monitoring for asbestos levels in the air near the ACD operational area. These data will be obtained from NRMRL/STD.
- Particle Size Distributions by Wide-Range Particle Spectrometer (WPS). The EPA's National Decontamination Team will make particle size distribution measurements during the testing using an MSP Wide-range Particle Spectrometer WPS™ (Model 1000XP). The WPS measures particle number concentration and particle size distribution (PSD) of aerosol particles from 10 nm to 10,000 nm (0.01μm to 10 μm) in diameter.

  This instrument will be used to conduct non-critical, real-time PSD measurements to investigate both the grinding and burning operations subject to changes in process parameters. For the testing of the grind operation, the WPS sampling probe will be placed at an appropriate location (yet to be determined) downwind from the grinding operation. For the testing of the burn operation, the WPS probe will be inserted into the stainless steel sample line at a location co-located with one of the other samples (i.e., Port 1 through 5).

  The WPS will be treated like a CEM instrument and whenever possible, will be operated continuously throughout the sampling periods. Any downtime will be noted in the laboratory notebook. PSD sample data will be collected onto a laptop personal computer that is dedicated to this instrument. To provide redundancy, the electronic files from the sample runs will be downloaded to a USB flash drive at the end of each sample day and will be provided to the project leader.

  The WPS samples aerosol at a rate of 1.0 liter per minute. 0.7 L/min of this flow is directed through a Laser Particle Spectrometer for particle sizing and counting in the 350nm to 10,000nm diameter range. The remaining 0.3 L/min is directed through a miniature Differential Mobility Spectrometer to count and size aerosol particles in the 10 to 500 nm diameter range (see accompanying figure). Details regarding the instrument calibration and operation will be incorporated as per the WPS Recommended Operating Procedure (ROP) attached to this QAPP.

B10 – Data Management

A data management system will be in place to assure the safe storage and integrity of the collected data. The elements of this system involve the prompt generation of replicate copies of paper and electronic records. The ARCADIS Project Manager is responsible for ensuring that a data management system is in place and that all parties that generate data are trained in the use of that system.

B10.1 Manually Collected Raw Data

Test data that are manually recorded will be entered into bound data books with pre-numbered pages using black ink pens. For this purpose, commercially available laboratory notebooks will be used to record general operator observations, comments and notations. Critical test data will be entered into bound data books that contain specially designed forms and datasheets. The pages in the data books will be pre-numbered. All pages of laboratory notebooks and data books must be accountable at all times. Where appropriate, the same notebooks used during the preliminary observations of an ACD operation in October 2005 will be continued.

A set of photocopies of the laboratory notebooks and the data books pages will be made. These copies will be stored in 3-ring binders and will be in the custody of the ARCADIS Project Engineer. At the end of the test campaign, the 3-ring binder will be transferred to the ARCADIS Project Manager.

B10.2 Electronically Collected Raw Data

The source of electronically collected data will be in the form of digital data files created by the various data acquisition systems. At the end of each test day, the raw data files will be copied to removable storage media (e.g. floppy disk, memory stick, ZIP disk, writable CD). These removable media will be in the custody of the Field Team Leader. Where possible, multiple copies of data files will be made to minimize the potential data loss. At the end of the test campaign, the removable storage media will be transferred to the ARCADIS Project Manager.

B10.3 Data Reduction/Computation Paper Worksheets

Upon completion of data computations, a copy set of the paper worksheets will be transferred to the ARCADIS Project Manager. The Field Team Leader will retain and store the original worksheets.

B10.4 Computer-Based Data Reduction/Computation Worksheets

It is anticipated that much of the computations will be performed on personal computers using spreadsheet software such as Microsoft EXCEL. A copy of the computation template workbook will be provided to the ARCADIS Project Engineer and the QAO prior to its use for the data manipulation. The ARCADIS Project Engineer and the QAO will review and confirm the correctness and completeness of the computation algorithm.

Computation results, including the complete data set identification information and raw data (when feasible) will be printed on paper to produce an indelible permanent record. Computer files for each data set will be uniquely identified by its computer file name and stored on magnetic media. The file names will consist of the following components:

- Method designator
- Date

- Run number
- The word “raw” or “reduced” to signify data processing status
- Operator last name

All data manipulations are to be performed on a **COPY** of the raw data, **NOT** on the raw data file itself. The integrity of the raw data file is to be maintained and **NO** changes are to be made to the raw data file after data collection for that particular test run is complete.

The ARCADIS Project Engineer will provide a set of the paper results and the computer files to the ARCADIS Project Manager.

B10.5 Analytical Data Reports

Analytical reports will be prepared by the various analytical laboratories and provided as paper copies delivered to the ARCADIS Project Engineer. The subcontracted laboratories have been directed to provide ARCADIS with their highest level of reporting for this project (Level 4 data packages). Analytical data packages will include all supporting QA/QC results including all initial calibrations, calibration verifications, and raw data chromatograms for the associated samples. Upon receipt of these reports, the Field Team Leader will promptly make two sets of photocopies and deliver the copy set to the ARCADIS Project Manager and the ARCADIS QAO respectively. Data will be validated by the ARCADIS QAO and ARCADIS Project Engineer prior to entry into emissions calculation spreadsheets. Validation will be according to EPA procedural guidelines.

B10.6 Transfer to EPA

At the completion of this project, ARCADIS will provide a full set of the raw and reduced data, along with the computation paper and computer worksheets to the ARCADIS Project Manager. Interim raw and reduced data will be provided to the ARCADIS Project Manager as requested during the course of the test program. The paper records will be photocopies of the original documents. Computer records will be in the form of computer program/data files and will be delivered on CD-ROMs. Any QA/QC problems will be reported to EPA by the ARCADIS QA Officer.

SECTION C

ASSESSMENT AND OVERSIGHT

C1 – Assessments and Response Action

Assessments are an integral part of a quality system. This project is assigned a QA Category II/III and will require planned technical systems and performance evaluation audits. The EPA QA Manager will coordinate any audits with the EPA Project Officers. The audit will be coordinated with the EPA Project Officers and ARCADIS Project Engineer. A summary of the findings from the audit will be included in the QA/QC section of the project report. Since spiked samples will be used to assess laboratory performance, no additional internal performance evaluation audits by ARCADIS are planned.

To ensure that subcontracted laboratories adhere to the procedures documented in the QAPP and the applicable standard methods, the ARCADIS QAO or her designee will perform on-site systems audits at the laboratories that cannot provide ARCADIS with up-to-date certifications and/or current proficiency audit results for the analyses they are contracted to perform. The Data Manager, Gene Stephenson will perform an assessment of 100% of the data gathered. The ARCADIS QA Officer will also perform an assessment of the data gathered from the site. This review will include at least 20% of the data from collection to reporting. Calculations will be checked, laboratory and analytical reports will be reviewed, and hand-entered data will be validated.

C2 – Reports to Management

All assessments performed by the EPA QA Representative or internally by the ARCADIS QAO will be formally reported to the EPA Project Officers and ARCADIS Project Manager within 30 days. Findings from the audits will be reported immediately in order for any necessary corrective actions to be implemented.

This page intentionally left blank.

SECTION D

DATA VALIDATION AND USABILITY

D1 – Data Review, Verification, and Validation

Daily test summaries will be developed as the tests proceed. These summaries will include preliminary data where available, mostly from CEM and temperature measurements. The purpose of these summaries is to keep the involved parties abreast of developments and to communicate any changes in direction that may be needed in response to the data collected to that point. These summaries will be drafted by the EPA combustion project lead.

Final data reviewers will include representatives from EPA's Office of Air and Radiation, Office of Enforcement and Compliance Assurance, Office of Research and Development, Region 6, and the Environmental Unit within the EPA Incident Command Structure; and the Louisiana Department of Environmental Quality. These reviews will in particular evaluate the conclusions drawn from the data and the potential for using the data in subsequent risk analyses and decision making. Comments from these reviews will be incorporated as appropriate into interim and final reports developed from the tests.

D2 – Verification and Validation Methods

Verification and validation of the procedures used to collect and analyze data are critical to the goals of this project. Project personnel will be responsible for ensuring that the sampling methods, quality control protocols, and validation methods described in earlier sections of this document are followed and completed. The first step in validating the data collected during the project is to assess if the project, as executed, meets the sampling design. This validation will be done by referencing data recorded in the field notebooks. Test dates and times will be reviewed to ensure that testing was performed as scheduled with test methods performed sequentially or simultaneously as designed. Test locations, and the methods used for data collection are checked against the project design. Actual procedures documented in field notebooks are checked against the procedures outlined in this document. Deviations from the QAPP will be classified as acceptable or unacceptable, and critical or non-critical. Any deviations from the QAPP will be documented in the Final Report. The analytical procedures performed during the test program will be checked against those referenced in this document. Deviations from the QAPP will be classified as acceptable or unacceptable, and critical and non-critical. Any deviations from the QAPP will be documented in the Final Report. The ARCADIS QA Officer will perform data validation of laboratory reports by reviewing raw data and the associated calibration reports and QC sample information to ensure that established acceptance criteria are met. Any data that does not meet method acceptance criteria will be flagged and its usefulness evaluated. QC procedures performed during the test program will be checked against those previously described. Omissions will be discussed with the EPA Project Officers and included in the Final Report. All

results outside specified parameters will be discussed with EPA Project Officers for corrective action. In some cases, reference methods have guidance on corrective action.

D3 – Reconciliation with User Requirements

The primary question to be addressed with these data is whether C&D debris can be burned in an ACD without generating lasting adverse environmental impacts. Key among the concerns is the emission level of asbestos, lead, and mercury.

Ideally, the tests would provide a bright line that would distinguish acceptable and unacceptable operating conditions. It is more likely, however, that the data will lie along a continuum of emission levels, which will require an analysis of the relative risks associated with the different disposal options. That analysis is beyond the scope of this effort, but the data reported from this effort will be used to develop that analysis.

The data that will be provided to the risk analysis effort will cover the critical measurements, and will highlight any data that are questionable or incomplete. Measurements that do not meet the data quality objectives will be examined in detail to understand the reasons for the failure. Although we will not report data that are clearly in error because of instrument failure, excessive measurement bias, or other reason that results in measurements that are invalid, measurements that do not meet the data quality objectives for other reasons (high variability or lack of duplicate measurements) will be reported but with the appropriate caveats. In the current situation, in which there is an absence of any data, we will have to rely upon any measurements that we can demonstrate to be valid.

It is understood that a clear decision to permit or prohibit ACD use will need to be made. Independent interpretation of the results by several experts will provide the most effective means of ensuring that such a decision is based on the best information available. Ultimately, this decision is a policy judgment that is based on technical findings, balanced against other environmental and public health risks (such as extended use of temporary housing). The ultimate goal of this QAPP is to enable ORD to provide EPA and LDEQ policy makers with guidance regarding the uncertainty associated with any conclusions based on the data collected during these tests.